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THE FALL ARMY WORM, OR "GRASS WORM," AND ITS CONTROL

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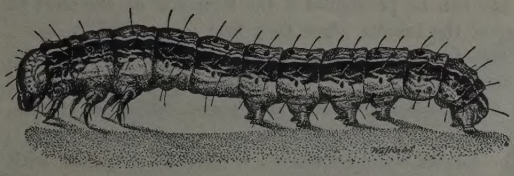
Entomological Assistants, Cereal and Forage Insect Investigations



FARMERS' BULLETIN 752

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from Bureau of Entomology
L. O. HOWARD, Chief

Washington, D. C. November, 1916

IN PRACTICALLY all cases where the fall army worm commits serious injuries to cultivated crops the damage can be prevented if the farmer is on the alert to discover the insects when they first appear.

Every farmer should possess a practical spraying outfit. He should also keep on hand at all times a few pounds of one of the standard insecticides, such as arsenate of lead, Paris green, or arsenite of zinc.

The farmer should cultivate a spirit of suspicion with regard to this insect and realize that the finer the stand of young grain, the more tempting the bait for the army worm, and that a field of corn, beautiful, green, and rustling in the breeze, may at the same time have millions of young army worms devouring the crab grass between its rows, easily controlled if sprayed with arsenicals to-day, but which by to-morrow may have caused irreparable damage to his crops. In such cases a delay of twenty-four hours in securing advice or insecticides is usually fatal.

THE FALL ARMY WORM,[1] OR "GRASS WORM," AND ITS CONTROL.

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INTRODUCTION.

This bulletin has been prepared with the intention of supplying the farmer and others with the necessary information for the control of the fall army worm (see illustration on title-page), together with a brief natural history of the species.

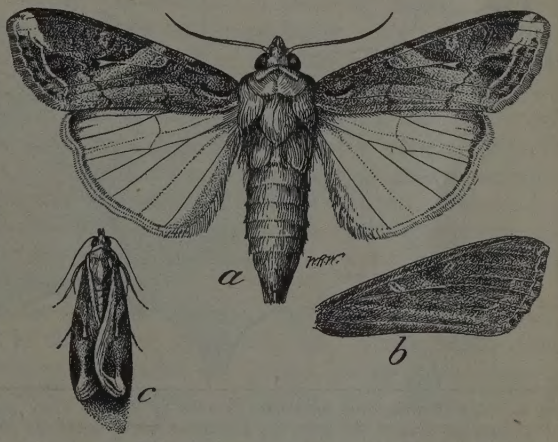

FIG. 1.—The fall army worm: *a*, Male moth; *b*, right front wing of female both; *c*, moth in resting position; *a*, *b*, about twice natural size; *c*, very slightly enlarged. (Original.)

This pest, which should not be confused with the true army worm,[2] is known, throughout the range of its injurious abundance, under many different names, some of which are the "grass worm," "overflow worm," "southern army worm," "Daggy's corn worm," "grass army worm," "alfalfa worm," etc. In Texas it is frequently called the "budworm." It is known in the North as the fall army worm because it occurs north of the Mason and Dixon line only in the late summer and fall. However, the injury inflicted by it under any of these names is usually disastrous to the farmer.

GENERAL DESCRIPTION.

The adult or parent of the fall army worm (fig. 1), a grayish moth, or "miller," is seldom noticed, and the farmer is far more likely to

[1] *Laphygma frugiperda* S. and A.; order Lepidoptera, family Noctuidae.
[2] The true army worm, *Cirphis unipuncta* Haw., is treated in Farmers' Bulletin 731.

see the full grown, nearly bare, striped caterpillars (fig. 1), his attention being called most forcibly to them by the widespread injury which they produce.

WHERE THE FALL ARMY WORM OCCURS.

During periodical outbreaks the fall army worm is found throughout almost the entire United States east of the Rocky Mountains, from Texas to Montana in the West and from Florida to Maine in the East. (Fig. 2.) It has also occurred recently in the Salt River Valley and at Yuma, in Arizona. Ordinarily it is apparently confined to the Gulf States, but under conditions favorable to its development this pest spreads northward as the summer advances, multi-

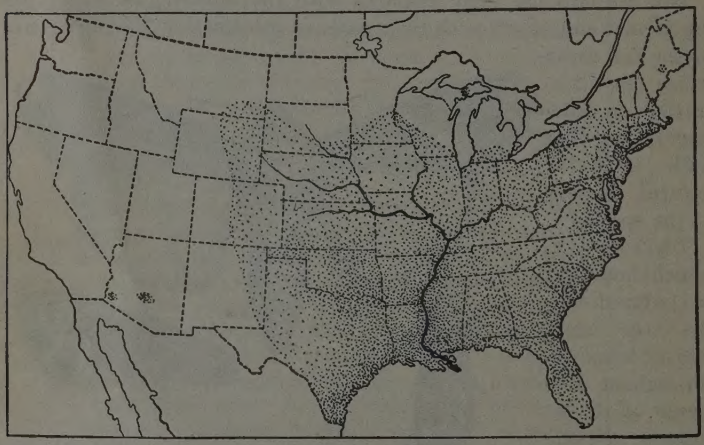

FIG. 2.—Map showing area sometimes invaded by the fall army worm. In the extreme southern portions of this area the fall army worm is always present. (Original.)

plying to such an enormous extent as to cause widespread and immense damage to cultivated crops throughout its range.

This pest is present every year in Central America, Mexico, and the West Indies Islands, and it seems quite possible that our worst outbreaks of the insect originate in these regions.

ECONOMIC IMPORTANCE AND MANNER OF INJURY.

The economic importance of this periodical invader, in the corn and cotton growing sections of the United States, can scarcely be exaggerated. The damage done by it in the Southern States during 1912 alone was enormous.

The caterpillars are exceedingly voracious in their nearly full-grown stage and devour stupendous quantities of food, eating almost continuously until they are ready to change to the adult form. They

usually feed more actively at night than during the daylight hours and more on cloudy days than on those during which the sun is shining brightly; but when they are numerous and food is not plentiful they may be seen many times taking or seeking food all day long, even in bright sunny weather.

CROPS ATTACKED.

The fall army worm attacks a great variety of crops, but its favorite food plants undoubtedly are the native grasses such as quack or crab grass, Bermuda grass, bluegrass, Johnson grass, etc. Where these plants are present in abundance it seldom attacks cultivated crops, and this serves to emphasize the necessity of clean cultivation, especially as regards corn, which is usually attacked only after the wild grasses, allowed to flourish between the rows, have been consumed. When the worms are observed feeding on such grasses these should be sprayed immediately with a solution of powdered arsenate of lead, 1 pound, or arsenite of zinc, 1 pound, to 50 gallons of water, in order to kill them before they attack the corn.

Besides corn, among cereal and forage crops, the fall army worm seriously injures kafir, rice, oats, millet, alfalfa, clover, sorghum, and cowpeas. The caterpillars are very fond of young sorghum. In the South, where it is a common practice to plant sorghum and cowpeas together for a hay crop, these worms frequently devour the sorghum plants from among the cowpeas—leaves, stem, and all, down to the very ground.

Cotton is severely injured at times, the caterpillars frequently cutting the tops of the plants completely off. Among other cultivated plants sometimes attacked are potato, sweet potato, turnip, spinach, tobacco, tomato, cabbage, cucumber, and grape. A full list of its occasional food plants would occupy so much space as to be out of place in this publication. In the cities of the North the fall army worm often devours the grass on lawns so rapidly as to cause consternation and astonishment to the owners.

WHERE INVASIONS OF THE FALL ARMY WORM ORIGINATE.

This insect is undoubtedly a native of tropical or subtropical America. It is apparently unable to survive the winter north of southern Georgia or central Texas, and, for this reason, is able to spread throughout the regions commonly visited by severe frosts only during the warmer portions of the year. During the years of its greatest abundance in the Southern States large numbers of the parent moths fly northward, by the aid of favorable winds sometimes making flights of hundreds of miles. After such flights the moths evidently lay their eggs at some chosen spot, the eggs hatch

and a fresh outbreak begins, and the female moths developing from the larvæ again fly northward before depositing their eggs. In this manner the fall army worm during favorable summers manages to spread over the entire eastern portion of the United States, even reaching southern Canada before the severe frosts of autumn intervene and halt its northward flight.

WHEN INVASIONS MAY BE EXPECTED.

General invasions of the fall army worm occur almost invariably following cold, wet springs. In some parts of the Mississippi Valley the pest is known as the "overflow worm," since the farmers attribute outbreaks of the insect directly to the overflowing of the great river, and it should be stated that there is evidence which appears to support this belief. The effects of cold and dampness on the insect enemies that ordinarily control the fall army worm are apparently disastrous, while such conditions have little or no ill effect on the caterpillars of the pest. It may be for this reason that local outbreaks occur nearly every year in the South in scattered localities after periods of heavy, localized rainfall and humid weather.

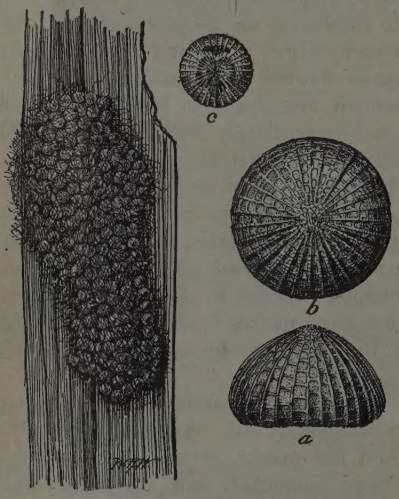

FIG. 3.—Eggs of the fall army worm: Egg mass at left about twice natural size; *a*, highly magnified egg, side view; *b*, same, view from above; *c*, greatly enlarged egg about ready to hatch, larva showing through the shell. (Original.)

LIFE HISTORY.

The fall army worm, in common with many other insects, passes through four stages in its development: First, the egg; then the larva, or caterpillar, which is the stage of growth and injury to crops; then the pupa, or resting stage; and, finally, the stage of the moth, or mature insect.

THE EGG STAGE.

The eggs (fig. 3) are laid by the moths at night in clusters of from 50 to several hundreds, preferably on grass blades. Low-lying fields thickly covered with grass or small grains are often chosen

for this purpose, and hence the outbreaks usually originate in bottom land. Sometimes, however, especially in cities, the eggs are laid among the grass blades on lawns. The color of the eggs is light gray and they are always more or less thickly covered with grayish down from the moth's body. The eggs hatch in from 2 to 4 days in the South, but sometimes require 10 days in the cooler climate of the Northern States.

THE CATERPILLAR, OR LARVAL, STAGE.

The newly hatched caterpillars (fig. 4) are very small and have jet-black heads and white bodies. They feed near the surface of the ground; thus, although myriads of them may be present, they are hidden from sight, and as they consume comparatively little food at this stage of their development the farmer does not often become aware of their presence. They feed first upon the shells of the eggs which have contained them, but soon begin to devour the crop. If the infestation is discovered at this time it usually can be brought quickly to an end by spraying with insecticides, or by mowing off the crop and then covering the infested spots with straw and burning them over.

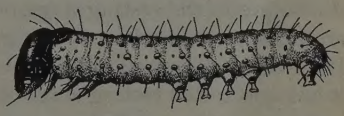

FIG. 4. — The fall army worm: Newly hatched larva, or "worm." Greatly enlarged. (Original.)

Within three or four days after hatching the young caterpillars have grown rapidly, turned much darker in color, and have begun to do considerable damage to the crop. At this time they do not entirely consume the leaves of the food plant, but skeletonize them, leaving the veins and ribs and whitish patches, which are conspicuous when seen against the green of the healthy portions of the leaf. The larvæ may be found in a curled position in the leaf sheaths, or possibly suspended by threads, but more than likely they will be found on the ground underneath the injured plant. The prompt application of arsenicals at this time is an easy matter, and is very effective in controlling the pest.

FIG. 5.—The fall army worm: Head of larva, front view. Greatly enlarged. (Original.)

From two to three weeks after hatching the caterpillar becomes fully grown. It is then striped, nearly naked, and about 1½ inches in length. (See title-page.) In this stage the fall army worm resembles the caterpillar of the true army worm so closely that it is practically impossible for the farmer to distinguish them. The caterpillar of the fall army worm usually has the front of the head marked with a more or less distinct inverted Y (fig. 5), but this character is not always sufficiently well marked to serve as a reliable means of iden-

tification, as this caterpillar varies in color from light greenish to almost black. In their last stages of growth the fall army worms consume quantities of food which are really vast in comparison with their size. By this time they are devouring every blade and leaf, leaving only the toughest parts of the plant stems uneaten. If the appetite of the worms is still unsatisfied when all of their local food supply has been eaten they mass together and crawl or "march" in search of other crops, and this affords the farmer an opportunity of killing the pest in great numbers by one of the mechanical methods described on pages 14 and 15.

When the caterpillar of the fall army worm becomes full grown it changes to the resting stage, or pupa. As a usual thing, practically an inch or two, and by twisting and turning presses the earth away from the body on all sides, thus forming a small cell, within which it changes to the resting stage or pupa. As a usual thing, practically all the worms enter the soil at about the same time, and their sudden disappearance frequently causes astonishment and mystification to the uninitiated observer. After the cell is completed the caterpillar begins to shrink in length, and presently the skin splits and is shed and the pupa appears already formed beneath it.

FIG. 6.—The fall army worm: Pupa. About twice natural size. (Original.)

THE PUPA, OR RESTING, STAGE.

The pupa (fig. 6) of the fall army worm is somewhat similar to a shelled peanut or date seed in shape and size, but is rounded at one end and pointed at the other. The color at first is golden or reddish, but finally becomes almost black. The skin or covering of its body is smooth and leathery, and it has no legs and is unable to move any portion of its body but the tail, or abdomen.

If the soil containing these pupæ can be lightly cultivated at this time, the insects are easily destroyed, for their underground cells are broken up and the pupæ are thus crushed or exposed to the action of the sun, rain, and their wild-bird and other enemies.

The resting, or pupal, stage lasts from ten days to two weeks; then the skin of the pupa is burst and the moth or parent crawls forth and makes its way immediately to the surface of the ground.

THE MOTH, OR PARENT, STAGE.

The moth of the fall army worm is somewhat smaller than that of the true army worm, measuring about $\frac{3}{4}$ inch in length and a little less than $1\frac{1}{2}$ inches across its outspread wings, and these wings are

totally different in hue. The front wings (fig. 1) are dark gray in ground color and have a mottled appearance, and there is usually an irregular white or light-gray spot near their extreme tip. The front wings of the female (fig. 1, *b*) are usually much duller in color than those of the male. The hind wings of both sexes are white, but possess a pearly or pinkish luster; they are edged with a smoky brown line. The body of the moth is ash gray.

In the Gulf States there may be as many as six generations of moths in a given locality in one year, but five is probably the more usual number. In those regions where the winter temperatures descend much below the freezing point there is seldom or never more than one generation of the fall army worm in a given locality in any one year, as the moths resulting from an outbreak of the caterpillars almost invariably fly northward, sometimes for hundreds of miles, before laying their eggs. Thus, as the insects can not survive the winter in the North, this is the sole means of infestation for the Northern States, and if it were possible thoroughly to control the fall army worm in the Gulf States during the early spring, farmers in the North would probably never suffer from its ravages. As yet, however, no effective means of doing this has been discovered.

HISTORY OF THE FALL ARMY WORM IN THE UNITED STATES.

The fall army worm has been known as an injurious insect in Georgia since the year 1797 and perhaps earlier than this. It is recorded as having been particularly injurious in Florida in 1845, and it was at this time that the ditching method of destroying the "marching" worms, now in universal use, was first put into practice. In 1870 the insect was injurious in Missouri and Illinois and from then until 1899 more or less extensive damage by it occurred every few years. During the latter year an extensive outbreak of the pest occurred throughout South Carolina, North Carolina, Virginia, West Virginia, Indiana, Illinois, Missouri, Kansas and other western and northern States. The most severe general outbreak of this insect ever recorded occurred during the summer of 1912, when it swept almost the entire United States east of the Rocky Mountains, utterly destroying the corn and millet in parts of many southern States, severely injuring cotton and truck crops, and destroying the grass on lawns in cities as if by magic.

NATURAL ENEMIES.

INSECT ENEMIES.

Fortunately the fall army worm has several very efficient insect enemies which ordinarily succeed in keeping its numbers down, thus preventing serious outbreaks of the pest, except during years when exceptionally favorable conditions for the worm prevail.

In the southern portion of the country several wasplike enemies are always present, one of the most effective of these being a small,

FIG. 7.—*Chelonus texanus*, a parasite of the fall army worm. Greatly enlarged. (Original.)

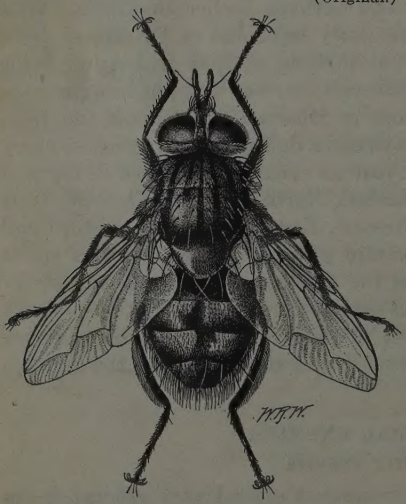

FIG. 8.—*Winthemia quadripustulata*, a fly parasitic on the fall army worm: Adult. Much enlarged. (Walton.)

black creature (fig. 7) which lays its eggs in the egg deposited by the fall army worm moth. Strange to say, instead of destroying this egg the young parasite remains inactive until the caterpillar has hatched and is partly grown, whereupon it devours the inside portions of the caterpillar's body, killing the pest.

Other valuable and effective insect enemies belong to a family of two-winged flies, not distantly related to that detested pest, the house fly. Some of these (see fig. 8) deposit their eggs on the bodies of the caterpillars, and the resultant maggots bore into the

caterpillar, soon killing it by devouring its internal organs and tissues. Another of these flies (fig. 9) lays exceedingly tiny eggs on the

FIG. 9.—*Archytas piliventris*, a fly parasitic on the fall army worm. Greatly enlarged. (Original.)

food plant of the fall army worm, which are swallowed by the unsuspecting caterpillar and hatch within its body, the maggots thereupon devouring the worm at their pleasure. Soldier bugs are numerous in some portions of the fall army worm's range. One of these, known as the spined soldier bug (fig. 10), kills and devours the caterpillars by piercing them with its strong beak and sucking out the liquid contents of their bodies. Both the old and young (fig. 11) bugs have this habit and are active enemies of the fall army worm.

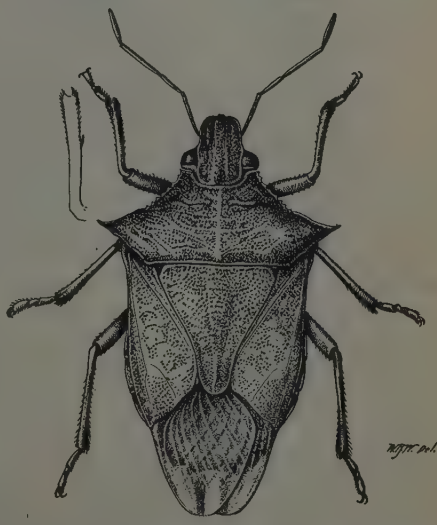

FIG. 10.—The spined soldier bug (*Podisus maculiventris*), an enemy of the fall army worm: Adult bug. Greatly enlarged. (Original.)

WILD-BIRD AND OTHER ENEMIES.

Among the important enemies of the fall army worm are our common wild birds. Some of these are the following: Crow blackbird or grackle, yellow-headed blackbird, chipping sparrow, bluebird, mocking bird, and meadowlark.

Domestic fowls will feed readily on the caterpillars if allowed access to infested fields, but will, of course, take only those individuals which they can reach from the ground.

Toads undoubtedly eat many caterpillars, while skunks feed upon the insects in both larval and pupal stages and are of far greater value to the farmer in this manner than is generally realized.

FIG. 11.—The spined soldier bug: Nymph, or young. Greatly enlarged. (Original.)

CONTROL MEASURES.

THE IMPORTANCE OF WATCHFULNESS AND PREPAREDNESS.

In practically all cases where the fall army worm commits serious injuries to cultivated crops the damage can be prevented if the farmer is on the alert to discover the insects when they first appear. Every farmer should possess a practical spraying outfit. Such outfits are not necessarily expensive, as they may be purchased at prices to suit almost any pocketbook. He should also keep on hand at all times a few pounds of one of the standard insecticides, such as arsenate of lead, Paris green, or arsenite of zinc. These are reliable and may be kept indefinitely without loss or deterioration in closed containers. A copy of Farmers' Bulletin No. 127 should be at hand, as this publication, which can be secured free of charge by application to the Secretary of Agriculture, tells how to mix and apply insecticides in controlling all classes of injurious insects. By observing these precautions and keeping a constant watch over his growing crops, the farmer should be in a position to meet invasions of fall army worms or other caterpillars and easily vanquish these pests before they have had a chance to commit serious damage to his crops.

The farmer should cultivate a spirit of suspicion with regard to this insect and realize that the finer the stand of young grain, the more tempting the bait for the army worms, and that a field of corn, beautiful, green, and rustling in the breeze, may at the same time have millions of young army worms devouring the crab grass between its rows, easily controlled if sprayed with arsenicals *to-day*, but which by to-morrow may have caused irreparable damage (fig.

12) to his crops. In such cases a delay of 24 hours in securing advice or insecticides is usually fatal.

SPRAYING FOR THE FALL ARMY WORM.

If the worms are found feeding in crab grass or other grasses or on grasslike grains other than corn, where the stand is not too thick

FIG. 12.—Corn plant, showing severe injury by the fall army worm. (Original.)

for the worms to be reached easily by the insecticide, they should be sprayed with a mixture of 1 pound of powdered arsenate of lead to 50 gallons of water, or, if the paste form of lead arsenate be used, 2 pounds to 50 gallons of water.

When feeding on corn the worms usually attack the bud of the plant first and are more difficult to reach because of the hairiness of the corn leaves. In this case a mixture of 2 pounds of powdered arsenate of lead or 3 to 4 pounds of the paste to 50 gallons of water is required, and the spray should be applied so as to force the fluid deep into the bud of the corn in order to reach the worms feeding

there. Paris green is sometimes used in place of arsenate of lead, but it should never be sprayed on corn unless lime has been added to it as follows: Paris green, 10 ounces; freshly slaked lime, 2 pounds; water, 50 gallons. If the poison is applied without the lime it will ruin the corn by burning.

White arsenic should never be applied to growing crops in any form, as it is strongly caustic and will burn them. Arsenite of zinc may be safely used as a spray in the proportion of 1 pound to 50 gallons of water if 1 pound of freshly slaked lime is added to the mixture. It may be applied in the same manner as the arsenate of lead spray.

THE POISONED-BRAN BAIT.

Under some conditions the poisoned-bran bait is of the greatest value in controlling the fall army worm. It is composed as follows: Wheat bran, 50 pounds; Paris green or white arsenic, 1 pound, or powdered arsenate of lead, 2 pounds); low-grade molasses, or "blackstrap," 2 gallons. The bran and insecticide are first mixed together dry, the molasses is then added, and the whole mass is thoroughly combined. In locations where the mixture dries out quickly, salt at the rate of 5 pounds to 50 pounds of bran tends to keep the bait in a moist condition and renders it more effective. In some cases the addition of six finely chopped lemons or oranges to the mixture has been found to be advantageous. The bait is usually scattered broadcast over the infested fields and seems to be especially effective when the caterpillars are "marching," or in fields where their preferred foods, such as the wild grasses, are not present or have been partly consumed.

MECHANICAL MEANS OF CONTROL.

When the fall army worm has exhausted its food in a restricted locality and the worms have massed together and "marched" away seeking a fresh supply of provender, a narrow ditch with steeply sloping sides should be dug or plowed out directly across the path of the marching worms. In attempting to cross this ditch the worms will gather in great quantities therein and may be destroyed easily by crushing them with a log dragged back and forth through the ditch. (Fig. 13.) Shallow postholes dug at frequent intervals in the bottom of the furrow will trap many worms, which then may be destroyed by crushing or otherwise. Where the subsoil is but slightly permeable, the holes may be partially filled with water and a layer of coal oil, or petroleum, maintained upon its surface. The coal oil will soon kill the worms that fall into the fluid.

SUMMARY OF CONTROL MEASURES.

(1) Provide yourself with a spraying apparatus and keep on hand several pounds of some standard insecticide such as arsenate of lead, arsenite of zinc, or Paris green.

(2) Watch carefully the grass growing among the cultivated field crops in the bottom lands or in the low places of the fields and upon the first indication of the presence of these caterpillars apply poison spray as recommended in this bulletin.

FIG. 13.—Ditch prepared to entrap marching army worms. A log, dragged back and forth through the ditch, crushes the worms that have fallen into it. (Walton.)

(3) In case of a general invasion, after the caterpillars have gone down into the ground in order to change to the next stage, which is the pupa, give the ground a light cultivation, wherever this is possible. This will cause the death of many of the fall army worm pupæ.

(4) When the caterpillars are on the march, or are starting in on one corner of a field of grain, head them off by plowing a deep furrow directly in front of them. Then kill the larvæ falling into this furrow by dragging a log through it. Where the whole field is infested, plow a furrow around it so as to keep the worms out of the surrounding fields. Keep the furrows free from rubbish so that the larvæ will have no means of crossing to the farther side.

(5) Spray infested grass and other vegetation that has no value with a mixture of Paris green and water, 2 pounds of the former to 50 gallons of the latter. Do not use the sprayed grass or vegetation for forage.

Spray growing grasses and other forage crops intended for use at a considerably later date with one of the following mixtures:

(*a*) Arsenate of lead (powder form)	1 pound.
Water	50 gallons.
(*b*) Arsenate of lead (paste form)	2 pounds.
Water	50 gallons.

When corn is infested, apply one of the following poisonous mixtures:

(*a*) Arsenate of lead (powder form)	2 pounds.
(Or paste form, 4 pounds.)	
Water	50 gallons.
(*b*) Paris green	1 pound.
Lime (freshly slaked)	2 pounds.
Water	50 gallons.
(*c*) Arsenite of zinc	1 pound.
Lime (freshly slaked)	1 pound.
Water	50 gallons.

Never use white arsenic on plants; it will burn them.

(6) An immense amount of good can be accomplished in destroying these worms by the use of a poisoned bait which is scattered broadcast over the infested fields. Take 50 pounds of bran and mix with it either 1 pound of Paris green or 2 pounds of lead arsenate, then add 2 gallons of low-grade molasses and 6 finely chopped lemons. This is especially recommended for fields containing mixtures of grass and cowpeas, cowpeas and sorghum, or fields in which grass has been consumed by the caterpillars.

CAUTION: Do not pasture stock in fields where the grass or other crops have been sprayed with a poison mixture until after heavy rains have fallen and not before three weeks after the application of the insecticides.

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